NHTSA'S TIRE PRESSURE SPECIAL STUDY, FEBRUARY 2001

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ABSTRACT

In 2000, Congress passed the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act. Section 13 of this act directed the U.S. Department of Transportation to complete a rulemaking within one year. This rulemaking requires implementation of a warning system in new motor vehicles (to be phased-in beginning with model year 2003) to indicate to the operator when a tire is significantly underinflated.

In support of rulemaking activities mandated by Section 13 of the TREAD Act, the National Center for Statistics and Analysis of the National Highway Traffic Safety Administration has completed an intensive data collection effort on the state of America's tires. The Tire Pressure Special Study (TPSS) was designed to assess to what extent passenger vehicle operators are aware of the recommended tire pressures for their vehicles, the frequency and the means they use to measure their tire pressure, and how significantly the actual measured tire pressure differed from the manufacturer's recommended tire pressure. Measurements were taken and interviews were conducted to compile a rich database of over 11,000 passenger vehicles (44,000 tires).

This paper will discuss the methodology of the TPSS as well as the extent of under-inflation found in the field and the attitudes and maintenance habits of drivers.

BACKGROUND

Providing vehicle operators with a device that would alert them to under-inflation could result in a reduction in the number of associated tire failures which can cause a loss of control of the vehicle. Consequently, this information supports the Department of Transportation's Strategic Goal: Safety - by working towards the elimination of highway related deaths and injuries.

The data collected in the TPSS have been used in support of various rulemaking actions. These included an upgrade to the placement and contents of the vehicle placard and the requirement of an onboard tire pressure monitoring system.

The stringent requirement for enactment of the rule requiring tire pressure monitoring systems required that data on the frequency and pervasiveness of under-inflation be collected and provided in a short time period. To minimize the survey start-up and to provide a trained cadre of data collectors, field data collection was conducted through the infrastructure of the National Automotive Sampling System (NASS) Crashworthiness Data System (CDS). The NASS CDS is a nationally representative sample of all police-reported motor vehicle traffic crashes that occur in the United States in which at least one passenger vehicle was towed from the crash scene due to damage from the crash.

SAMPLE DESIGN

The CDS consists of teams of researchers located at twenty-four Primary Sampling Units (PSUs) throughout the United States. The PSUs are a probability sample selected from a frame of all geographic areas in the continental United States. The PSUs were selected based on the number of motor vehicle traffic crashes occurring within their regions in which at least one person involved in the crash was killed or injured.

The population surveyed by the researchers in the TPSS represents a sample frame consisting of drivers who used gas stations to refuel their passenger vehicles between the hours of 8:00 am and 5:00 pm. Data collection was conducted during a two-week period in February 2001.

The sampling stages for the TPSS are as follows:

- Stage 1 – Selection of the CDS PSUs
- Stage 2 – Selection of the Zip Codes
- Stage 3 – Selection of the Gas Stations
- Stage 4 – Selection of the Vehicles

The first stage of sampling for the Tire Pressure Special Study is the selection of the NASS CDS PSUs. For the CDS, the continental United States was grouped into 1,195 Primary Sampling Units (PSUs). PSUs were either central cities, the balance

of a county containing a central city, a county, or a group of counties. From the 1,195 PSUs, a stratified (geographic region and size) sample of twenty-four PSUs was selected using a probability proportional to size (PPS) procedure with a measure of size (MOS) equal to the number of fatal and injury producing motor vehicle traffic crashes.

The second stage of sampling was the selection of zip codes within the twenty-four CDS PSUs. A random selection of seven zip codes from a list of eligible zip codes within each of the twenty-four PSUs was selected. A zip code was eligible if it contained at least two gas stations with more than one service island with a canopy over the islands. The gas stations must also be at least two miles apart. The CDS data collection teams identified zip codes within their PSU and provided the list to NHTSA where the sample of zip codes was selected.

The third stage of sampling was the selection of gas stations within each zip code. Within each of the seven selected zip codes, the CDS Data Collection Team listed all qualifying gas stations. From this list, the CDS data collection team selected two gas stations at random and sought cooperation with each prior to the start of the study. In the event of the refusal of a gas station to cooperate, the next gas station on the list (after the random selection) was chosen as an alternative. If a gas station initially agreed to cooperate, but on the date scheduled for data collection refused to cooperate, again, the next gas station on the list was substituted as an alternative. The fourteen selected gas stations within a PSU were assigned to one of the fourteen days of the data collection period.

The final stage of sampling is the identification of motor vehicles and motor vehicle operators from which to collect the data. At each sampled gas station, data from approximately forty passenger motor vehicles (passenger cars, pickup trucks, vans, and sport utility vehicles) coming to the gas station for refueling were collected. Additionally, the goal was to observe ten vehicles within each vehicle category (passenger cars, pickup trucks, vans, or sport utility vehicles) coming to the gas station for refueling. Each of the fourteen days of data collection was divided into the following time intervals: 8 am – 10 am, 10 am – noon, noon – 2 pm, 2 pm – 4 pm, 4 pm – 5 pm. The CDS data collection team began each time interval of data collection by counting all eligible vehicles entering the gas stations for refueling for a fifteen minute period. At the end of the fifteen minute period, the next eligible vehicle entering the gas station was asked to cooperate in the survey. Data was collected for this vehicle and when collection was complete, the next eligible vehicle entering the gas station for refueling was surveyed. If more than one vehicle entered the gas station and one was of a type for which fewer observations had been collected, that vehicle took precedence for data collection. Teams collected data throughout all five time periods regardless of the number of vehicles observed.

Vehicles surveyed included passenger cars and light trucks. NHTSA classifies light trucks as sport utility vehicles, pickup trucks and vans with a gross vehicle weight rating of less than or equal to 10,000 pounds. A total of 11,530 vehicles were included in the survey, of which 6,442 were passenger cars, 1,874 were sport utility vehicles, 1,376 were vans, and 1,838 were pickup trucks. The distribution of vehicles was consistent with national estimates of vehicle registration.

Estimation

To simplify and unify estimating procedures, weights were produced for all sampled vehicles accounting for the sample design. The base weight, which is the reciprocal of the probability of the selection of the PSUs, the zip codes within the PSUs, and the gas stations within the zip codes reflected the sampling stages. Hence, the base weight for a selected gas station, BWT_G, is given by:

$$BWT_G = \frac{1}{P_{PSU} \times P_{Zip} \times P_G}$$

where

P_{PSU} = Probability of selection of PSU;

P_{Zip} = Probability of selection of the zip code within the PSU; and

P_G = Probability of selection of the gas station within the zip code and PSU.

In order to get unbiased estimates for driver characteristics in the population, a base weight, BWT_{Vi}, was defined for each vehicle sampled in each of the four vehicle categories and was given by:

$$BWT_{Vi} = \frac{BWT_G \times E(N_i)}{n_i}$$

where

$E(N_i)$ = the expected number of vehicles in the i-th vehicle category coming to the gas station during the entire survey period (calculated using the vehicle tallies from the Daily Site Information Forms);

n_i = the sample of vehicles selected; and

i = represents each of the four vehicle body type categories.

DATA COLLECTION METHODOLOGY

Data collected during the TPSS included daily site information, driver interview and profile data, vehicle profile data, and tire data for all four tires on the vehicle.

The **Daily Site Information Form** contained information regarding the number of vehicles by body type category coming into the gas station for refueling during each day. The vehicles were observed for fifteen-minute time periods every two hours. This included a total count for each body type category as well as a total count of all vehicles. The Daily Site Information Form also contained information regarding the presence and operation of a site's air pressure pump available for customer use. Pump data collected included availability, use fee, functionality, air pressure gauge presence, and accuracy.

The **Driver Interview Form**, which was completed for each observation, contained information regarding the extent to which the driver was aware of the recommended air pressure for his/her vehicle's tires, if he/she monitors the air pressure in the tires, and how he/she monitors the air pressure. If the driver was neither the vehicle's primary driver nor responsible for the vehicle's maintainence, then none of the tire pressure knowledge or maintenance questions were asked. The form also contained driver profile data documented by the researcher.

The **Vehicle Inspection Form**, which was completed for each observation, contained vehicle profile information such as make, model, and model year. It also contained information documented from the vehicle's placard regarding recommended tire size, recommended air pressure, and the gross axle weight rating.

The **Tire Inspection Form**, which was also completed for each observation, contained tire size and measurement information. In addition, the form contained the ambient air temperature at the time of the observation.

Data from the field was sent to the quality control centers (Zone Center) for review, then delivered to NHTSA for final review.

Data Collection Process

Each data collection team consisted of two to three researchers. This team size was chosen in order to expedite data collection and minimize the impact on the gas station. Each observation took approximately six to eight minutes. One researcher was tasked to garner cooperation with the participant, and to collect data on the Interview Form and the Vehicle Inspection Form. The second (and third if present) researcher collected data on the Tire Inspection Form. At the conclusion of each observation, the participant was given a courtesy card which contained the air pressure measured on each tire, the vehicle manufacturer's recommended cold tire pressure, and several tire safety tips.

Special Equipment

Special equipment used for data collection included pyrometers to measure tire sidewall temperature and ambient air temperature, an air pressure gauge to measure tire pressure, and a tread depth indicator to measure tread depth. The only limitation to the equipment regarded the air pressure gauge. The gauge only measured pressures between 0 and 60 psi. Any pressures measuring 60 or above were coded as "60+."

The pyrometers used in the study were checked against each other prior to each data collection day. If the pyrometers did not measure the same ambient air temperature (within a tolerance of one degree), the researchers noted the discrepancy on the Daily Site Information Form.

The air pressure gauges used in the study were tested for calibration prior to each data collection day. The test was conducted using the two air pressure gauges assigned to each team. The tire pressure of a vehicle belonging to one of the researchers was checked with both gauges. If the pressures were not within a 1 psi tolerance they were to notify their Zone Center for immediate replacement. If the researcher could not determine which gauge was inaccurate, both gauges

were replaced. No problems were noted with any of the equipment used in the study.

At the end of each day the research team documented the presence and function of any customer-use air pressure pump at the data collection site. The researchers checked the functioning status of the pump and whether there was any fee for use. In addition, the researchers checked the accuracy of any pressure gauges attached to the pump. This was accomplished by bleeding the air on the tires of one of the researchers' vehicle to 10 psi. The researcher then inflated the tire until the vehicle manufacturer's recommended pressure was met. The researcher then checked the pressure with one of the supplied air pressure gauges. If the pressure was within ±1 psi, the pressure gauge was deemed to be accurate.

The data collection forms, procedures, and methods were tested during both the alpha and beta testing prior to study implementation.

ANALYSIS AND RESULTS

Survey data were analyzed for the following three categories of vehicles:

1) Passenger Cars with P-Metric Tires (Cars w/ P Tires);
2) Pickup Trucks, Sport Utility Vehicles, and Vans with P-Metric Tires (Light Trucks w/ P Tires);
3) Pickup Trucks, Sport Utility Vehicles, and Vans with Other Type Tires (Light Trucks w/ Other Tires).

P-Metric tires are regular passenger car tires. Their labeling has the format "P205/75R14." Other Type tires include LT tires, which are light truck tires with the sample format "LT235/85R15/D," and High Flotation tires that have the sample format "31X10.50R15LT/C." Information on standard tire labeling formats can be found in the "2000 Tire Guide" courtesy of the Rubber Manufacurers Association.

Estimates and Sampling Error

The observations were weighted to represent national estimates. Because estimates from the TPSS are based on a sample, they are statistically weighted according to the sample design and are subject to sampling error. When calculated, estimates in the tables are shown with their corresponding sampling error in parentheses. Adding and subtracting twice the sampling error from the corresponding estimate will produce an approximate 95 percent confidence interval for the estimate. This means that one can be 95 percent confident that the true value for the quantity being estimated lies within this interval.

Results of Driver Interviews

Tables 1and 2 show the results of the question: "Is maintaining proper tire inflation a concern for you?"

As shown in Table 1, eighty-five percent of drivers interviewed reported that they are concerned about proper inflation. There did not appear to be any significant difference in percentage when broken out by vehicle body type and tire type.

Table 1
Percentage of Drivers Concerned About Maintaining Proper Tire Inflation By Type of Vehicle and Response (Estimates and Sampling Errors in Percentages)

Vehicle Type	Response	
	Concerned	Not Concerned
Cars w/ P Tires	84 (2.6)	16 (2.6)
Light Trucks w/ P Tires	87 (2.5)	13 (2.5)
Light Trucks w/ Other Tires	88 (3.8)	12 (3.8)
Overall	**85 (2.3)**	**15 (2.3)**

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 2 shows that only 68 percent of drivers between the ages of 16 and 24 were concerned about maintaining proper tire inflation, but, as can be seen from Table 3, 75 percent of that age group were responsible for the maintenance of their vehicle.

Table 3 shows that 82 percent of drivers between the ages of 25 and 69 are responsible for the maintenance of their vehicle, and, as can be seen from Table 4, only 71 percent of females compared to 87 percent of males are responsible for the maintenance of their vehicle.

Table 2
Percentage of Drivers Concerned About Maintaining Proper Tire Inflation By Age Group and Response (Estimates and Sampling Errors in Percentages)

Age Group	Response	
	Concerned	Not Concerned
16-24	68 (6.1)	32 (6.1)
25-69	88 (1.4)	12 (1.4)
Over 69	89 (3.7)	11 (3.7)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study

Table 3
Percentage of Drivers Responsible for the Maintenance of their Vehicles by Age Group and Response (Estimates and Sampling Errors in Percentages)

Age Group	Response	
	Responsible	Not Responsible
16-24	75 (3.0)	25 (3.0)
25-69	82 (1.3)	18 (1.3)
Over 69	86 (4.3)	14 (4.3)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 4
Percentage of Drivers Responsible for the Maintenance of their Vehicles by Gender and Response (Estimates and Sampling Errors in Percentages)

Gender	Response	
	Responsible	Not Responsible
Male	87 (1.3)	13 (1.3)
Female	71 (2.7)	29 (2.7)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

If the driver of the vehicle was also the "primary driver" and "responsible for the maintenance of this vehicle," additional questions were asked. The results for some of these questions are shown in Tables 5 through 16.

Tables 5 through 8 show the results of the question: "How often do you check your tire pressure?" Drivers interviewed were not given multiple choices but were asked to provide a time period. The responses were then categorized into their most common occurrences.

Table 5 shows that drivers of light trucks with other tires check their tires more frequently (48 percent weekly or monthly) than do drivers of cars and light trucks with passenger car tires (less than 35 percent weekly or monthly). The most frequent response for drivers of vehicles with passenger tires was "when serviced." It should be noted that vehicle manufacturers usually recommend an oil change/service visit every 3,000 miles for those who drive under severe conditions (multiple short trips, stop and go driving, cold weather, hot, dusty conditions, tow trailers, heavy loads) and between 5,000 and 7,500 miles for those who drive under normal conditions (ref: Automotive Oil Change Association). It should also be noted that at some service stations checking tire pressure should not be assumed to be a routine maintenance along with an oil change and the customer should specifically request to have his or her vehicle's tire pressure checked. In its list of routine maintenance included with one of their premier tune-up packages, one service center admits "visually inspect and correct tire pressure." (ref: www.pepboys.com/service/tune-ups.shtm)

Some "other" responses included "daily by visual inspection", "biannually", and one driver responded "when I yell at him (her husband) enough." Twenty-five percent of drivers responded that they check their tire pressure "when it seems low" giving examples of "visual inspection", "change in handling characteristics", and "tires squealing."

Table 5
Percentage of Drivers Who Check Their Tire Pressure by Type of Vehicle and Frequency
(Estimates and Sampling Errors in Percentages)

Vehicle Type	Response						
	Weekly	Monthly	When They Seem Low	When Serviced	Before a Long Trip	Other	Does Not Check at All
Cars w/ P Tires	9 (0.7)	21 (1.4)	26 (3.7)	30 (2.8)	1 (0.2)	6 (0.8)	7 (0.9)
Light Trucks w/ P Tires	9 (0.7)	25 (1.2)	24 (3.4)	28 (4.0)	2 (0.6)	8 (1.0)	4 (0.9)
Light Trucks w/ Other Tires	8 (2.5)	40 (5.9)	16 (5.1)	26 (3.0)	2 (1.1)	7 (1.9)	2 (0.9)
Overall	**9 (0.7)**	**24 (1.0)**	**25 (3.4)**	**28 (3.0)**	**2 (0.4)**	**7 (0.8)**	**5 (0.8)**

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 6 shows that 40 percent of females check their tire pressure only when their vehicle is serviced, an alarming 11 percent do not check their tire pressure at all.

Tables 7 and 8 show the results of frequency of checking tire pressure by the demographics of race and age.

Table 6
Percentage of Drivers Who Check Their Tire Pressure by Gender and Frequency
(Estimates and Sampling Errors in Percentages)

Gender	Response						
	Weekly	Monthly	When They Seem Low	When Serviced	Before a Long Trip	Other	Does Not Check at All
Male	11 (1.0)	30 (1.1)	26 (3.6)	21 (2.9)	2 (0.4)	8 (0.8)	2 (0.4)
Female	6 (0.8)	15 (1.2)	22 (3.6)	40 (3.7)	1 (0.5)	6 (0.9)	11 (2.5)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 7
Percentage of Drivers Who Check Their Tire Pressure by Race and Frequency
(Estimates and Sampling Errors in Percentages)

Race	Response						
	Weekly	Monthly	When They Seem Low	When Serviced	Before a Long Trip	Other	Does Not Check at All
White	8 (0.7)	24 (1.1)	25 (1.1)	28 (3.1)	1 (0.4)	8 (4.8)	5 (1.0)
Hispanic/ Latino	14 (2.8)	26 (2.5)	17 (3.2)	29 (8.1)	4 (2.0)	4 (0.7)	5 (0.8)
Black/ African American	11 (2.0)	22 (2.8)	28 (3.5)	23 (3.6)	1 (0.3)	6 (1.5)	10 (1.8)
Other	6 (1.6)	28 (3.3)	17 (4.0)	35 (6.2)	0 (0.3)	9 (3.9)	4 (1.0)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 8
Percentage of Drivers Who Check Their Tire Pressure by Age Group and Frequency
(Estimates and Sampling Errors in Percentages)

Age Group	Response						
	Weekly	Monthly	When They Seem Low	When Serviced	Before a Long Trip	Other	Does Not Check at All
16-24	8 (0.8)	17 (1.9)	32 (4.2)	25 (3.9)	1 (1.0)	7 (1.5)	10 (1.7)
25-69	10 (0.9)	25 (1.0)	24 (3.6)	27 (3.0)	2 (0.3)	8 (0.8)	3 (1.1)
Over 69	5 (1.4)	28 (1.5)	19 (3.6)	38 (3.8)	2 (0.7)	3 (1.1)	4 (1.6)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

NHTSA recommends that drivers take responsibility for the maintenance of their tires and the safety of their vehicles by checking tire pressure at least once a month and always before a long trip.

Tables 9 through 12 show the responses to the question: "How do you normally determine what pressure to set your tires?"

Table 9 shows that the most frequent response from drivers of sport utility vehicles, vans, and pickup trucks was that they determine the proper tire inflation level by referring to the tire label. Of those drivers of passenger cars who are responsible for the maintenance of their own vehicle, the most frequent response was also the tire label. It should be noted that the value on the tire label is the maximum pressure for that tire and the manufacturer's recommended tire pressure which can be found either in the owner's manual or on the placard can deviate significantly from the pressure listed on the tire. Only 25 percent of drivers knew to check their owner's manual or vehicle's tire placard to determine the proper tire inflation level for their vehicle. Some "other" responses included "the thumb test", "guessing", and several drivers said "use 32 all of the time".

The unknown column was used when the researcher could not get an answer to the question. It does not necessarily mean that the driver did not know how to determine proper tire inflation.

Table 9
Percentage of Drivers Using the Following References to Determine Proper Tire Inflation Levels for Their Vehicle by Type of Vehicle and Response
(Estimates and Sampling Errors in Percentages)

Vehicle Type	Response							
	Owner's Manual	Vehicle Placard	Tire Labeling	Visually	Other Person	Other Method	Does Not Know	Unknown
Cars w/ P Tires	18 (2.3)	8 (1.1)	22 (2.0)	11 (1.2)	24 (3.4)	10 (2.2)	7 (1.2)	1 (0.5)
Light Trucks w/ P Tires	15 (1.9)	7 (0.7)	31 (4.5)	8 (1.1)	23 (3.6)	10 (1.2)	4 (0.9)	2 (0.5)
Light Trucks w/ Other Tires	22 (8.9)	11 (4.1)	44 (6.1)	7 (2.2)	4 (1.4)	10 (2.4)	2 (0.9)	0 (0.1)
Overall	**17 (2.5)**	**8 (0.9)**	**27 (3.7)**	**10 (1.1)**	**22 (3.3)**	**10 (1.8)**	**6 (0.9)**	**1 (0.2)**

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 10 shows that while 20 percent of the female drivers check their owner's manual or the vehicle's tire placard, 13 percent check the tire label. However, 40 percent of the female drivers responded that another person is responsible for determining proper tire pressure. Of the male drivers, 36 percent use the tire label as their guide.

Tables 11 and 12 show the results of references used to determine proper inflation levels by the demographics of race and age.

Table 10
Percentage of Drivers Using the Following References To Determine Proper Tire Inflation Levels for their Vehicle
by Gender and Response
(Estimates and Sampling Errors in Percentages)

Gender	Response							
	Manual	Placard	Tire Labeling	Visually	Other Person	Other Method	Does Not Know	Unknown
Male	18 (3.1)	10 (1.1)	36 (4.7)	11 (1.5)	10 (2.4)	11 (2.0)	4 (0.8)	1 (0.2)
Female	15 (2.2)	5 (0.9)	13 (2.3)	8 (1.2)	40 (4.6)	8 (2.2)	9 (1.5)	2 (0.5)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 11
Percent of Drivers Using the Following References To Determine Proper Tire Inflation Levels for their Vehicle
by Race and Response
(Estimates and Sampling Errors in Percentages)

Race	Response							
	Manual	Placard	Tire Labeling	Visually	Other Person	Other Method	Does Not Know	Unknown
White	17 (2.6)	9 (1.3)	29 (3.7)	9 (0.9)	21 (3.4)	10 (1.9)	5 (1.0)	1 (0.2)
Hispanic/ Latino	17 (4.8)	4 (0.7)	26 (10.4)	6 (0.8)	28 (5.5)	11 (1.6)	7 (1.3)	2 (0.8)
Black/African American	18 (2.7)	5 (1.5)	19 (1.6)	18 (4.3)	22 (4.3)	7 (1.7)	9 (1.7)	2 (0.5)
Other	17 (2.3)	4 (1.1)	28 (5.5)	6 (1.5)	22 (7.3)	13 (4.8)	7 (1.8)	3 (1.1)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 12
Percent of Drivers Using the Following References to Determine Proper Tire Inflation Levels for their Vehicle
by Age Group and Response
(Estimates and Sampling Errors in Percentages)

Age Group	Response							
	Manual	Placard	Tire Labeling	Visually	Other Person	Other Method	Does Not Know	Unknown
16-24	14 (5.1)	5 (1.3)	27 (4.5)	14 (2.7)	21 (3.2)	8 (2.0)	9 (2.0)	1 (0.4)
25-69	17 (2.3)	8 (1.0)	29 (3.6)	9 (1.1)	21 (3.3)	10 (2.0)	5 (0.8)	1 (0.3)
Over 69	18 (1.7)	9 (1.2)	18 (5.0)	8 (1.4)	33 (3.7)	10 (5.4)	4 (1.4)	1 (0.2)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Tables 13 through 15 show the responses to the question: "How do you normally check your tires for proper inflation?" Table 13 shows that for the most part, and for all three categories of vehicles analyzed, drivers (48 percent) check their tire pressures by using a tire pressure gauge. A high percentage (15 percent) of people check their tire pressure visually.

Table 13
Percentage of Drivers Using the Following Methods to Check Their Tire Pressure by Type of Vehicle and Response
(Estimates and Sampling Errors in Percentages)

Vehicle Type	Response					
	Pressure Gauge	Visually	When Serviced	Other Person Responsible for Car	Other Method	Does Not Check at All
Cars w/ P Tires	42 (3.0)	16 (2.0)	27 (2.7)	10 (1.0)	1 (0.2)	4 (0.6)
Light Trucks w/ P Tires	51 (2.0)	13 (2.4)	24 (3.0)	8 (0.7)	1 (0.2)	2 (0.3)
Light Trucks w/ Other Tires	68 (7.4)	6 (1.2)	18 (6.9)	7 (2.9)	0 (0.0)	1 (0.2)
Overall	**48 (2.3)**	**15 (2.1)**	**25 (2.8)**	**9 (0.7)**	**1 (0.1)**	**3 (0.4)**

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Some "other" responses included "pound with a hammer", "press with finger", and several drivers said that they "kick the tires". When asked how often and by what methods he checks his tire pressure, one driver responded that he has a warning light. NHTSA would like to remind drivers that tire pressure monitoring systems should be used as a supplement to responsible tire maintenance and not as the primary indicator.

Table 14 shows that 61% of males use a tire pressure gauge when measuring their tire pressure, while only 25% of women do, many of whom have their tire pressure checked when their vehicle is serviced.

Table 14
Percentage of Drivers Using the Following Methods to Check Tire Pressure by Gender and Response
(Estimates and Sampling Errors in Percentages)

Gender	Response					
	Pressure Gauge	Visually	When Serviced	Other Person Responsible for Car	Other Method	Does Not Check at All
Male	61 (2.5)	16 (2.7)	18 (3.2)	3 (0.6)	1 (0.2)	2 (0.2)
Female	25 (2.6)	13 (1.8)	36 (3.5)	20 (2.0)	1 (0.3)	5 (0.9)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 15 shows that the method for checking tire pressure was fairly consistent across the age ranges, with more than 40% of people using a tire pressure gauge. An alarming 7% of those between the ages of 16 and 24 said that they do not check their tire pressure at all.

Table 15 Percentage of Drivers Using the Following Methods to Check Tire Pressure by Age Group and Response (Estimates and Sampling Errors in Percentages)						
Age Group	Response					
	Pressure Gauge	Visually	When Serviced	Other Person Responsible for Car	Other Method	Does Not Check at All
16-24	41 (3.3)	17 (3.9)	21 (2.8)	12 (1.8)	1 (0.4)	7 (1.5)
25-69	49 (2.5)	15 (1.8)	24 (3.1)	8 (0.8)	1 (0.2)	3 (0.3)
Over 69	45 (2.3)	8 (2.1)	37 (4.1)	8 (2.8)	0 (0.2)	1 (0.4)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Twenty-five percent of the people responded (from Table 13) that their tire pressure was checked when the vehicle was serviced. It has already been noted that some service centers do not include a tire pressure check with an oil change. For those who do check the tire pressure it is important to request that they inflate the tires to the vehicle manufacturer's recommended tire pressure, which can be found on the tire placard, and that the tire pressure is checked using a gauge.

NHTSA recommends that all drivers take reponsibility for the maintenance of their tires and the safety of their vehicles. Tire pressure should be checked at least once a month and before a long trip.

The proper tire inflation level to use can be found on the vehicle's tire placard or owner's manual and the tire pressure should always be checked using an accurate tire pressure gauge.

Results of Vehicle Observations

Table 16 shows the cumulative percentile of the difference between the measured pressure for each tire on the vehicle and the manufacturer's recommended cold tire pressure for that tire for passenger cars with P-Metric tires. Five percent of the left front tires were under-inflated by at least 9.9 psi. Twenty-five percent of the left front tires were under-inflated by at least 4.3 psi. Half of the left front tires were under-inflated by at least .8 psi. And seventy-five percent of the left front tires were under-inflated, or properly inflated, or over-inflated by not more than 2.7 psi.

Table 16 Difference Between the Recommended and the Measured Pressure for Passenger cars with P-Metric Tires by Tire Position and Percentile (Measured Pressures in psi)					
Tire Position	Difference in Pressure (psi)				
	5th Percentile	25th Percentile	Mean	50th Percentile	75th Percentile
Left Front	-9.9	-4.3	-0.2 (0.2)	-0.8	2.7
Left Rear	-13.0	-5.9	-1.9 (0.2)	-2.1	1.5
Right Rear	-12.5	-5.8	-1.8 (0.2)	-2.0	1.6
Right Front	-10.1	-4.5	-0.6 (0.2)	-0.9	2.3

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 17 shows the cumulative percentile of the difference between the measured pressure for each tire on the vehicle and the manufacturer's recommended cold tire pressure for that tire for light trucks with P-Metric tires. Overall, light truck tires are underinflated by one to one and a half psi more than passenger car tires.

Table 17 Difference Between the Recommended and the Measured Pressure for Light Trucks with P-Metric Tires by Tire Position and Percentile (Measured Pressures in psi)					
Tire Position	**Difference in Pressure (psi)**				
	5th Percentile	**25th Percentile**	**Mean**	**50th Percentile**	**75th Percentile**
Left Front	-10.5	-5.3	-1.1 (0.4)	-1.7	1.9
Left Rear	-12.7	-6.8	-2.8 (0.2)	-3.4	0.4
Right Rear	-13.7	-7.2	-3.1 (0.2)	-3.4	0.2
Right Front	-11.0	-5.6	-1.4 (0.4)	-1.9	1.5

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 18 shows the percentage of vehicles that have at least one tire underinflated by 8 psi or more. Twenty seven percent of the passenger cars have at least one tire which is underinflated by 8 psi or more. Of light trucks with P-Metric tires, 32 percent are underinflated by 8 psi or more. Light trucks with light truck and high flotation tires were not included in the analysis due to the 60 psi limitation of the pressure gauge.

Table 18 Percentage of Vehicles that Have at Least One Tire Underinflated by at Least 8 psi (Estimates and Sampling Errors in Percentages)	
Vehicle Category	**Percent**
Passenger Cars with P-Metric Tires	27 (1)
Trucks, SUVs, and Vans with P-Metric Tires	32 (1)

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 19 shows the percentage of tires that deviate from the manufacturer's recommended cold tire pressure (Delta P) by 8 psi or more by the age of the tire. Categories were broken down by age of vehicle and extent of misinflation. Most tires are within 8 psi. More tires are underinflated than overinflated.

There is also a correlation between the age of the vehicle and the deviation in pressure, with older vehicles deviating more than newer vehicles.

Table 20 shows the percentage of vehicles by number of tires that are underinflated by 8 psi or more from the recommended cold tire pressure. More than one-quarter of the passenger cars with P-Metric Tires have at least one tire underinflated by 8 psi or more. For the light truck category (trucks, vans, and SUVs) with P-Metric tires, almost one-third have at least one tire underflated by 8 psi or more. The proportion of light trucks where all four of the tires are underinflated by 8 psi or more is twice that of passenger cars.

Table 19 Percentage of Tires Deviating from the Manufacturer's Recommended Pressure by Vehicle Type, Delta P and Age of Vehicle (Estimates and Sampling Errors in Percentages)									
Vehicle Type	**Delta P (psi)**								
	Underinflated by 8 or more			**Inflated Within 8**			**Overinflated by 8 or more**		
	Vehicle Age in Years			**Vehicle Age in Years**			**Vehicle Age in Years**		
	≤ 3	**3 < y ≤ 6**	**> 6**	**Y ≤ 3**	**3 < y ≤ 6**	**y > 6**	**y ≤ 3**	**3 < y ≤ 6**	**> 6**
Cars with P-Metric Tires	8 (1)	11 (2)	15 (1)	86 (1)	82 (1)	78 (1)	6 (1)	7 (1)	7 (1)
Trucks, SUVs, and Vans with P-Metric Tires	12 (1)	15 (2)	24 (2)	82 (1)	80 (3)	71 (2)	6 (1)	5 (1)	5 (1)
Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.									

Table 20 Percentage of Vehicles by Vehicle Type and Number of Tires Underinflated by 8 psi or More. (Estimates and Sampling Errors in Percentages)					
Vehicle Type	**Number of Tires Underinflated by 8 psi or More**				
	0	**1**	**2**	**3**	**4**
Cars with P-Metric Tires	73 (2)	14 (1)	7 (1)	3 (0)	3 (0)
Trucks, SUVs, and Vans with P-Metric Tires	68 (2)	13 (1)	10 (1)	8 (1)	6 (1)
Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.					

CONCLUSIONS

The results of the Tire Pressure Special Study reiterate the importance of increasing the public's awareness of proper tire care and maintenance. In a country where 1 in 4 passenger cars and 1 in 3 light trucks have a significantly under-inflated tire, and only 1 in 4 drivers know how to determine the proper tire pressures for their vehicle, tire pressure monitoring systems have the opportunity to provide a substantial benefit. These systems in combination with a public awareness campaign could significantly improve these results.

The presence of tire pressure monitoring systems should be used as a supplement to regular tire maintenance and care. NHTSA recommends that each tire, including the spare, should be checked monthly when cold and set to the recommended inflation pressure as specified in the vehicle placard and owner's manual. It is important to note that a tire pressure gauge should be used when measuring tire pressure. Less than half of the respondents in the TPSS used a gauge when measuring tire pressure.

REFERENCES

United States Department of Transportation, National Highway Traffic Safety Administration. August 2001, "Tire Pressure Special Study: Methodology."

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